PMM Science Team Meeting

PMM Welcome and Program Status

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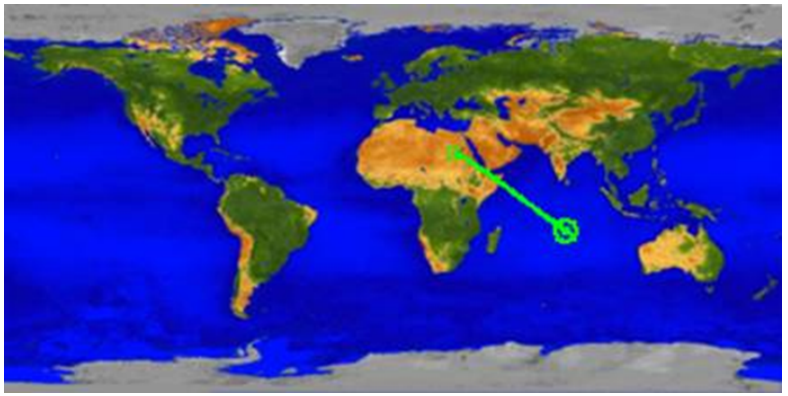
Precipitation Measuring Missions

GLOBAL PRECIPITATION MEASUREMENT

TRMM: Tropical Rainfall Measuring Mission

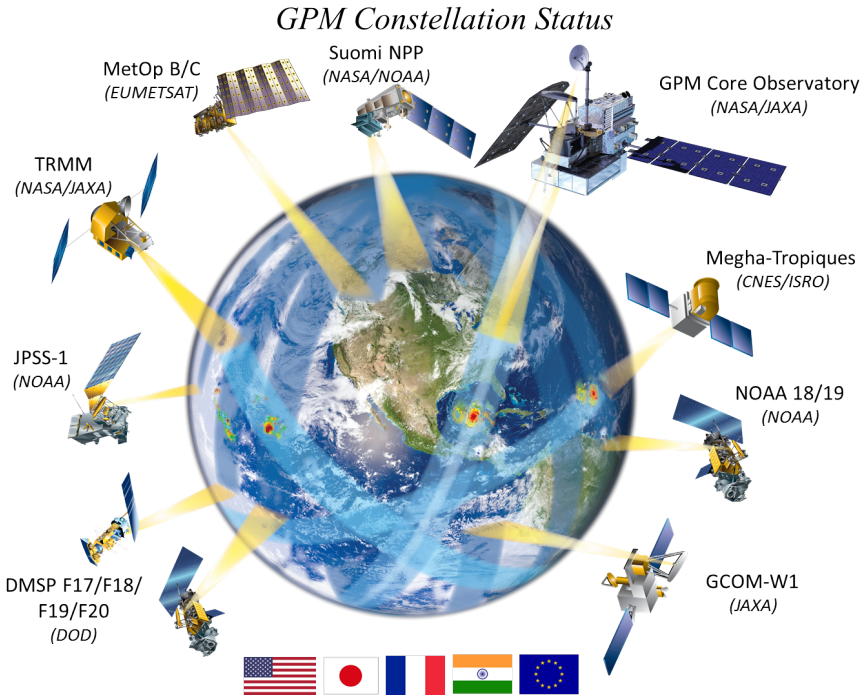
- Launched in 1997 to measure tropical rainfall
- After 17+ years of service the satellite was passivated in April 2015
- Partnership between NASA and the Japan Aerospace Exploration Agency (JAXA)

Re-entered the Earth's atmosphere on:
15 June 2015 at 11:55 p.m. EST



GPM: Global Precipitation Measurement
(launched February 2014 from Tanegashima)

- GPM builds upon TRMM's tremendous success and looks at precipitation with greater accuracy around the world
- GPM uses inputs from an international constellation of satellites to provide improved space and time coverage of precipitation

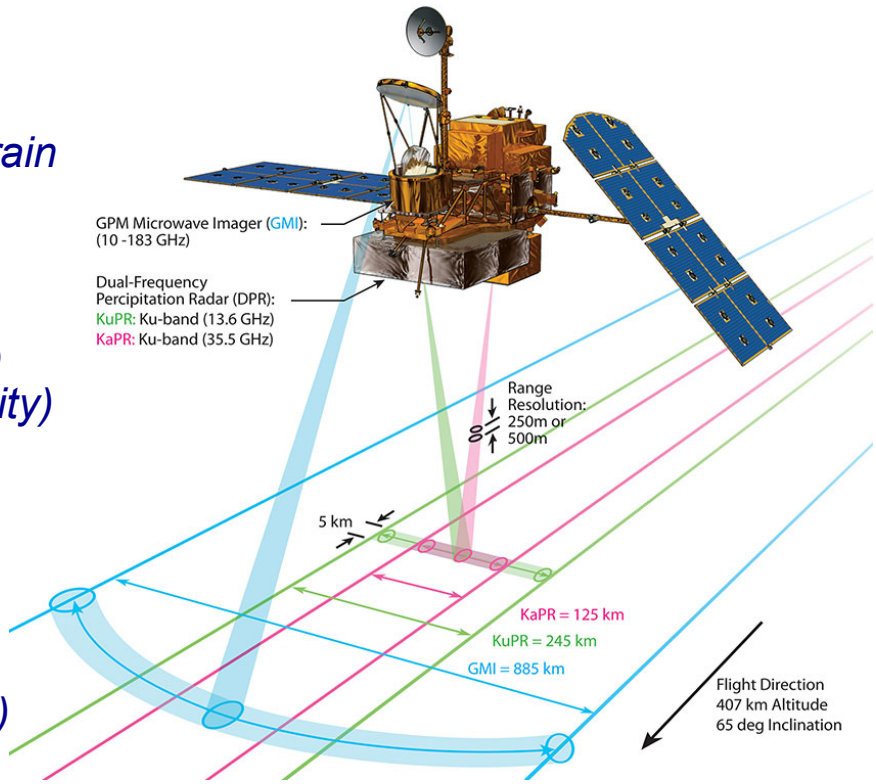


Dual-Frequency (Ku-Ka band) Precipitation Radar (DPR):

- *Increased sensitivity (~12 dBZ) for light rain and snow detection relative to TRMM*
- *Better measurement accuracy with differential attenuation correction*
- *Detailed microphysical information (DSD mean mass diameter & particle no. density) & identification of liquid, ice, and mixed-phase regions*

Multi-Channel (10-183 GHz) GPM Microwave Imager (GMI):

- *Higher spatial resolution (IFOV: 6-26 km)*
- *Improved light rain & snow detection*
- *Improved signals of solid precipitation over land (especially over snow- covered surfaces)*
- *4-point calibration to serve as a radiometric reference for constellation radiometers*



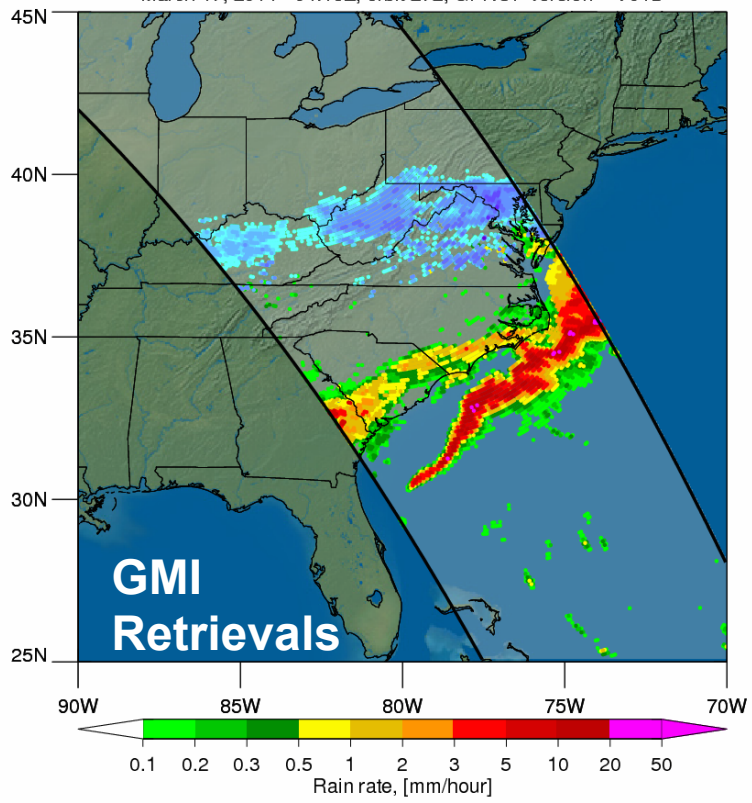
Combined Radar-Radiometer Retrieval

- *DPR & GMI together provide greater constraints o possible solutions to improve retrieval accuracy*
- *Observation-based a-priori cloud database for constellation radiometer retrievals*

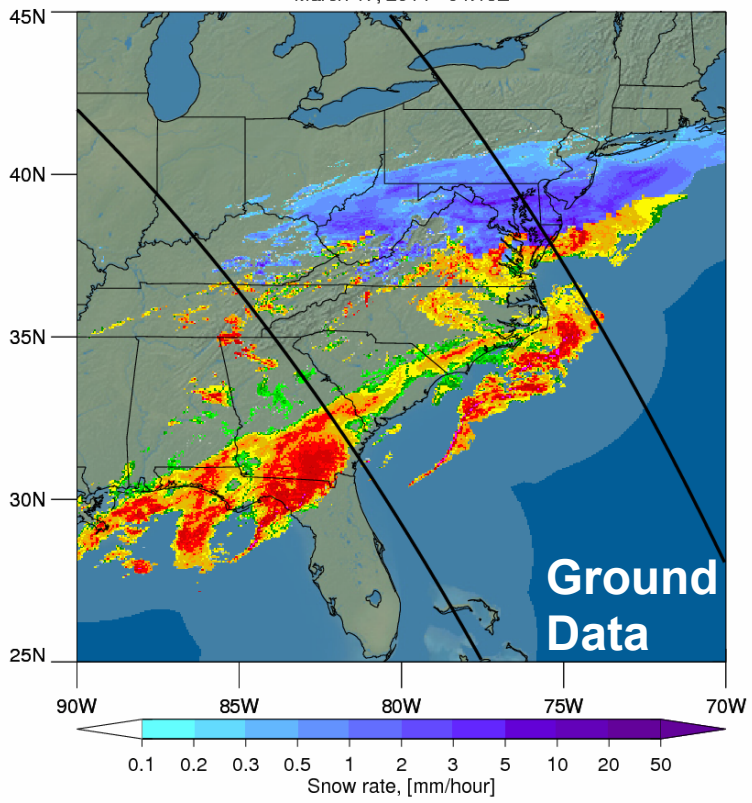
Falling Snow as Observed by GMI

NASA's GPM Microwave Imager (GMI) was specifically designed to detect falling snow. This snow event occurred March 17, 2014 and deposited more than 7" of snow in the Washington, DC metro area.

Bottom Left: GMI retrievals of liquid rain (greens to reds indicate light to heavy rain) and falling snow (blue shading).

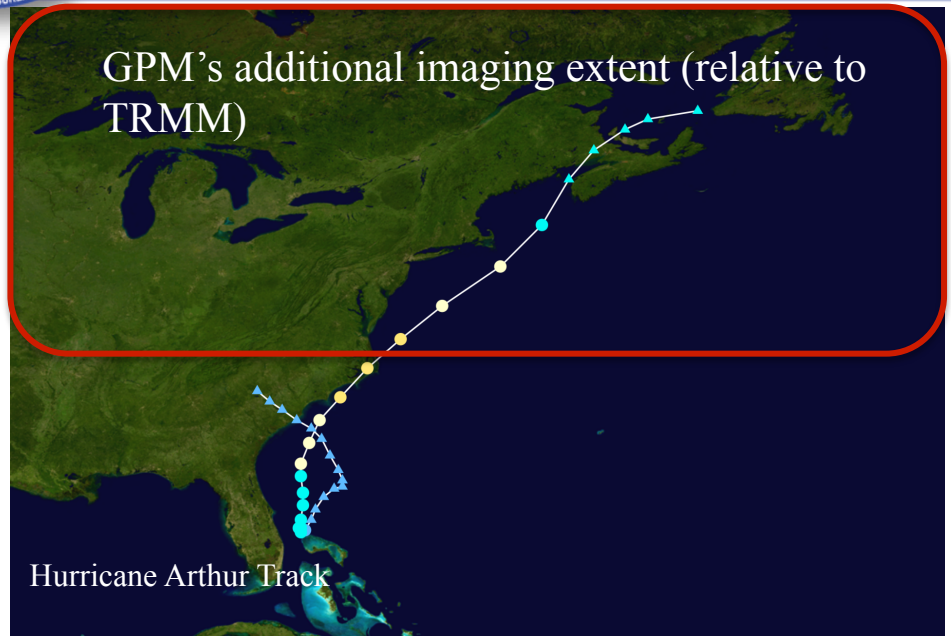


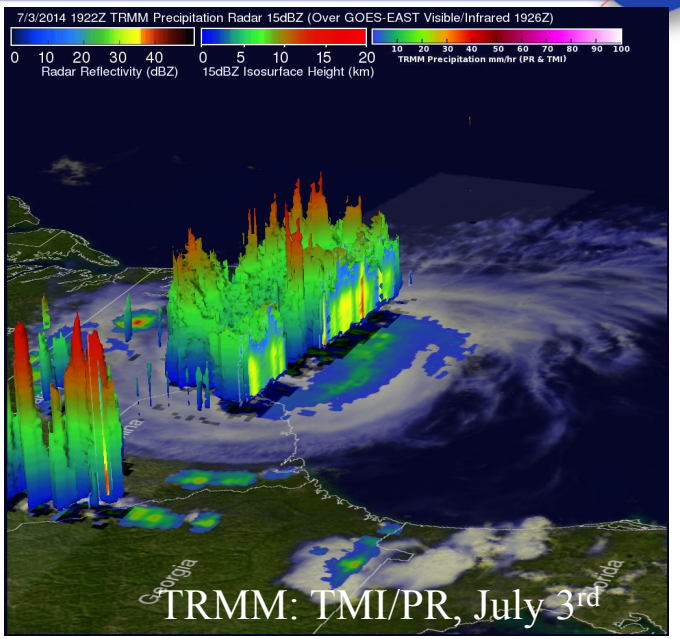
***Bottom Right*:** Ground measurements from NOAA's National Mosaic & Multi-Sensor QPE (CONUS 3D radar mosaic at 1km resolution).

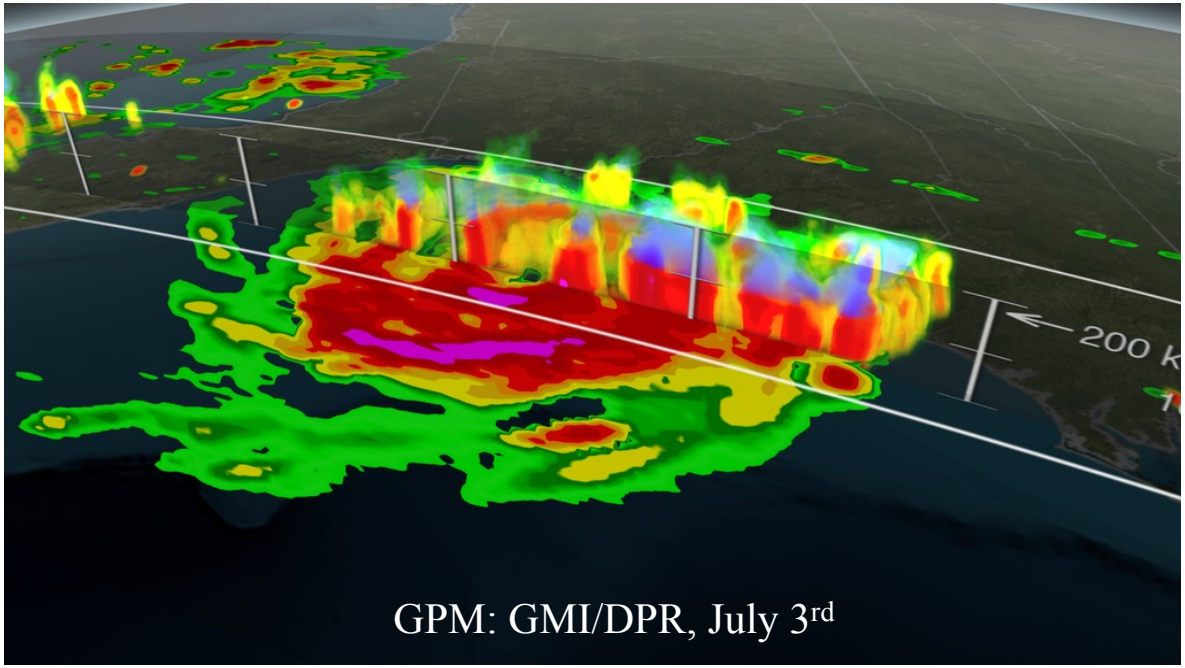


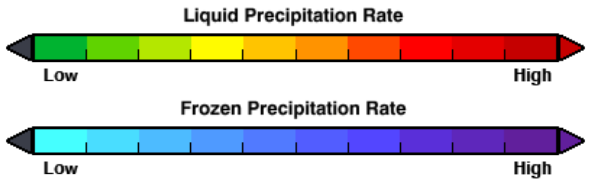
Courtesy Kummerow/Berg

Hurricane Arthur – July 1-7th, 2014



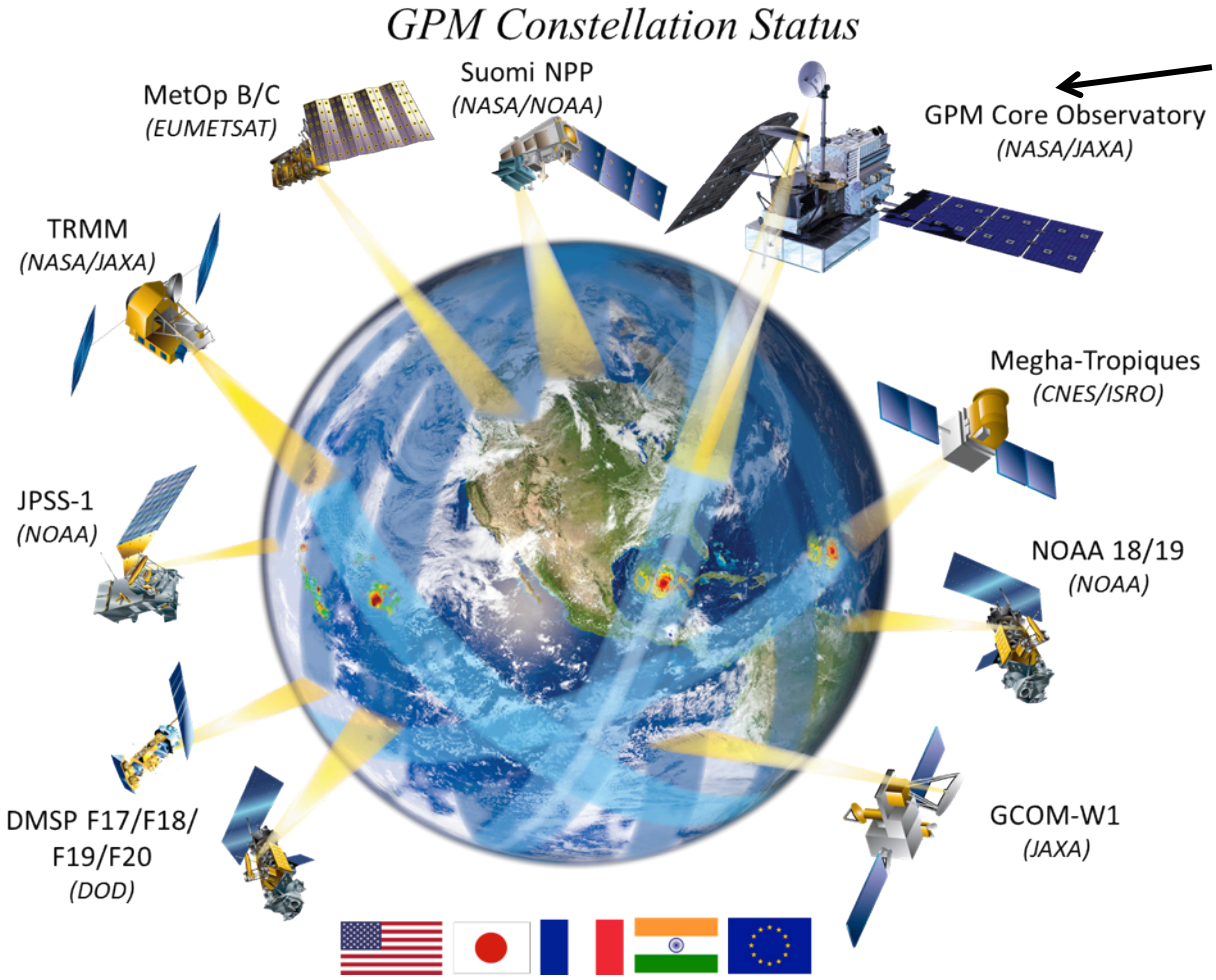






GLOBAL PRECIPITATION MEASUREMENT

GPM's International Constellation



GPM Core Observatory
(NASA/JAXA, 2014)
DPR (Ku & Ka band)
GMI (10-183 GHz)
65º Incl, 407 km altitude
5 km best footprint
0.2 – 110 mm/hr and snow

Active Joint Projects (19 PI's from 13 countries)

NASA Research Announcement

Science Mission Directorate
New NASA Research Announcement Expected
Precipitation Science Team
Solicitation: NNH15ZDA001N
Date Released February 2015
NOIs Due April 15, 2015
Proposals Due June 30, 2015
Funds likely to be available: ~ $7.5 M/year for 3 years
Number of Awards: 40-45 out of ~130 proposals

This solicitation will be for the selection of the 9th Precipitation Science Team

No-cost research proposals can be accepted from international investigators to complement existing science team activities

ROSES Research Categories

2.1. Algorithm/Product Validation and Enhancement (50% of available funding)

2.2 Utilization of Satellite/GV Products for Process Studies and Model Development (25% of available funding)

2.3. Methodology Development for Improved Applications of Satellite Products (25% of available funding)

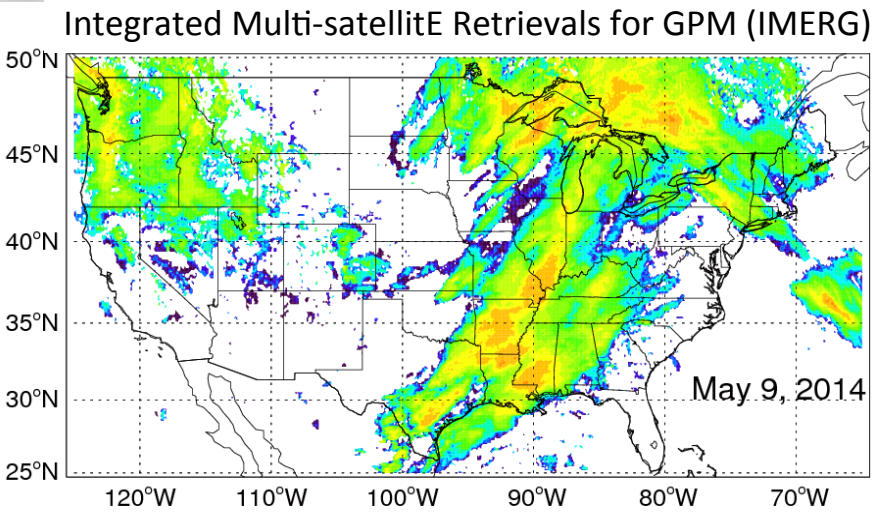
Precipitation Products and Release Schedule

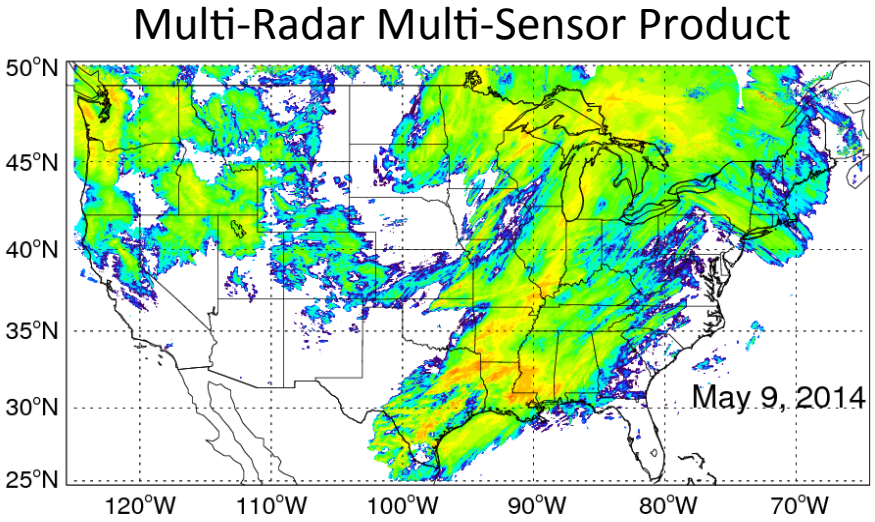
Product Level	Description	Coverage	Latency* & Public Release
Level 1B GMI Level 1C GMI	Geolocated Brightness Temperatures (TBs) and intercal TBs (1C)	Swath, instrument field of view (IFOV)	***1 hour latency products for applic. users*; Released June 16, 2014**
Level 1B DPR	Geolocated, calibrated radar powers	Swath, IFOV (produced at JAXA)	**Released Sept 2, 2014**
Level 1C, partner radiometers	Intercalibrated TBs	Swath, IFOV	**Released June 16, 2014**
Level 2 GMI (GPROF2014)	Radar enhanced (RE) precipitation retrievals	Swath, IFOV	***1 hour latency* Released July 14, 2014**
Level 2 partners	RE precip retrievals from 1C	Swath, IFOV	**Released July 14, 2014**
Level 2 DPR	Z, σ_0, Characterization, DSD, Precipitation w/ vert. structure	Swath, IFOV (Ku, Ka, combined Ku/Ka)	***3 hour latency;* Released Sept 2, 2014**
Level 2 Combined GMI/DPR	Precipitation retrievals constrained with DPR & GMI	Swath, IFOV	***3 hour latency;* Released Sept 8, 2014**
Level 3 LH	Latent Heating (LH) products	0.25^{o}x0.25^{o} monthly grd	**TBD**
Level 3 Instrument Accumulations	GMI, partner radiometers, combined and DPR	0.25^{o} x 0.25^{o} daily and monthly grid	**Released Sept 2, 2014**
Level 3 Merged Product (IMERG)	Merger of GMI, partner radiometer, and IR	0.1^{o} x 0.1^{o} at a 30 minute grid	**released Dec. 2014**

*All algorithms have additional latencies from 4 hours to 2 months after data collection for producing higher quality precipitation products for scientific investigations and climate studies

GLOBAL PRECIPITATION MEASUREMENT

IMERG Rain Accumulations and GV

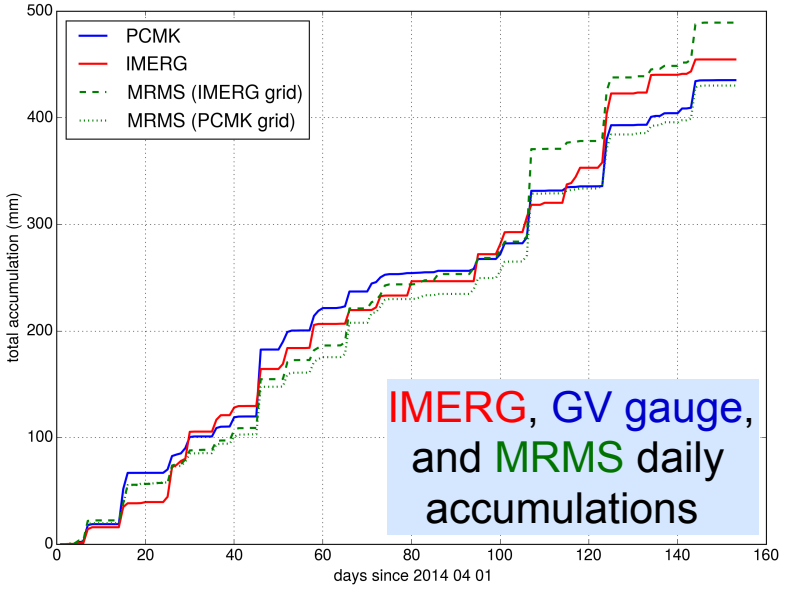


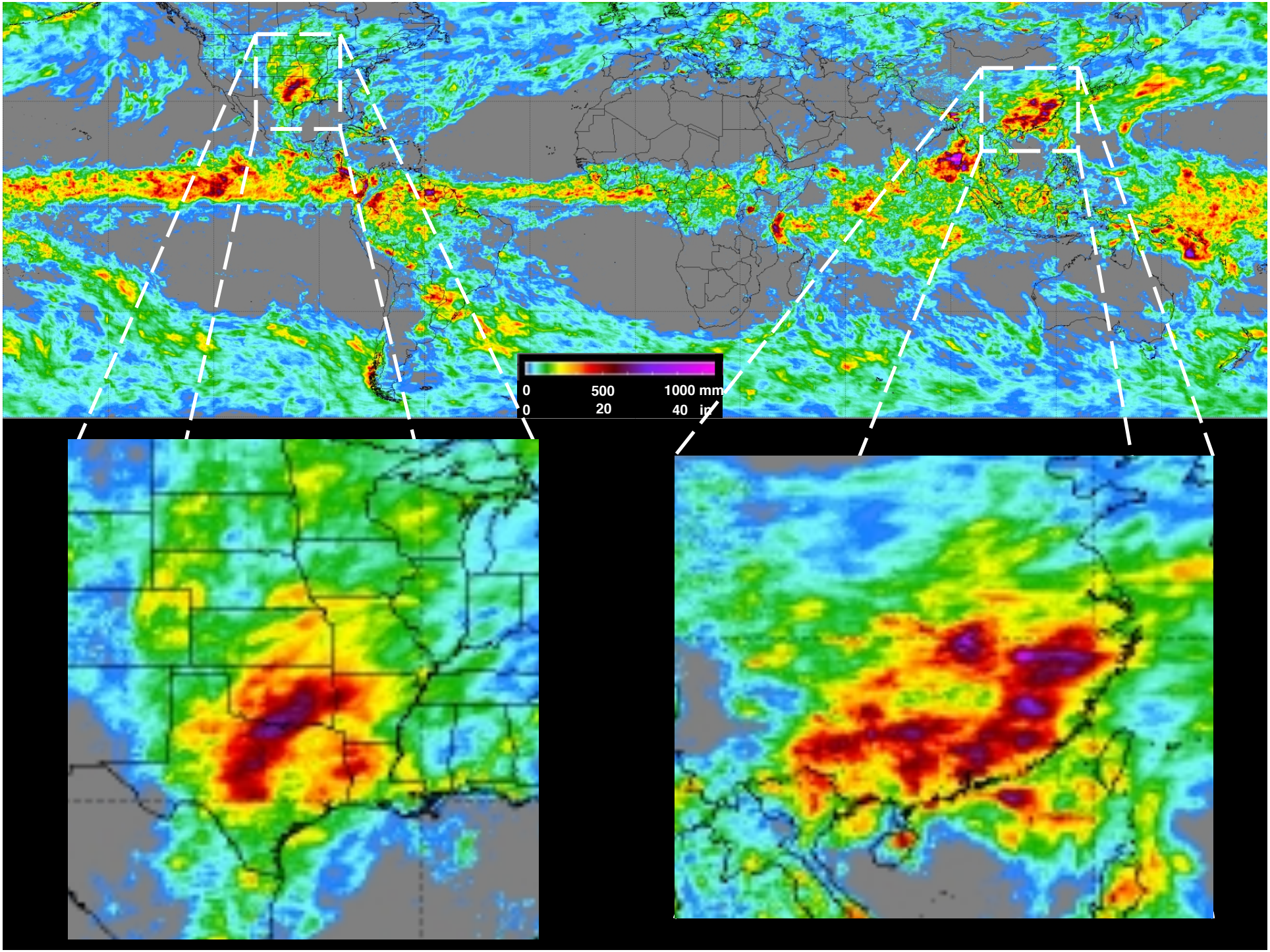


Continental-scale view of the U.S. GPM multi-satellite product IMERG, showing daily rain totals in reasonably good agreement with CONUS GV

Single grid-box comparisons over Wallops GV site also in agreement

Daily accumulations 4/1 – 8/1 2014




0
500
1000 mm
0
20
40 in

GPM sees extreme precipitation in the southern Plains States and around the globe

After three years of drought, the southern Great Plains States witnessed record rainfall and flooding in the spring of 2015. This map for May 2015 depicts the massive swaths of excessive rain that were observed by the Joint NASA/Japan Aerospace Exploration Agency (JAXA) Global Precipitation Measurement (GPM) mission. To do this, GPM operates a Core Observatory satellite that hosts the advanced GPM Microwave Radiometer and the Dual-frequency Precipitation Radar. Besides using these data directly, GPM uses them to adjust the precipitation estimates from the microwave radiometers that fly aboard about nine other satellites. These satellites are operated by other agencies for their own purposes, but the data are sent to GPM as well. After these adjustments, GPM creates a map of estimated precipitation that covers most of the globe every half hour.

After accumulating these maps for the entire month, it is easy to see not only the flooding rains in the U.S., but also in eastern and southern China. Similar to the U.S. southern Great Plains, excessive rains in China have wreaked havoc in many locations, triggering deadly floods and landslides that caused extensive property damage.<need more details?> The detail in these GPM precipitation maps allows the data to be used for similarly fine-scale estimates of flood and landslide occurrence around the world.

Looking more widely, the map reveals the patterns of precipitation over both land and ocean, providing critical information in places for which there is no possibility of obtaining routine measurements at the surface, including the oceans, unpopulated land areas, and conflict zones. This information is used in numerous scientific studies, from better understanding how precipitation is affected by other meteorological conditions to tracking El Niño events and specifying the current state of the climate. As well, practical applications start with flood and landslide analysis, but include crop forecasting, supporting insurance policy pay-outs, and assisting in forecasting outbreaks of water-related disease such as <give examples>

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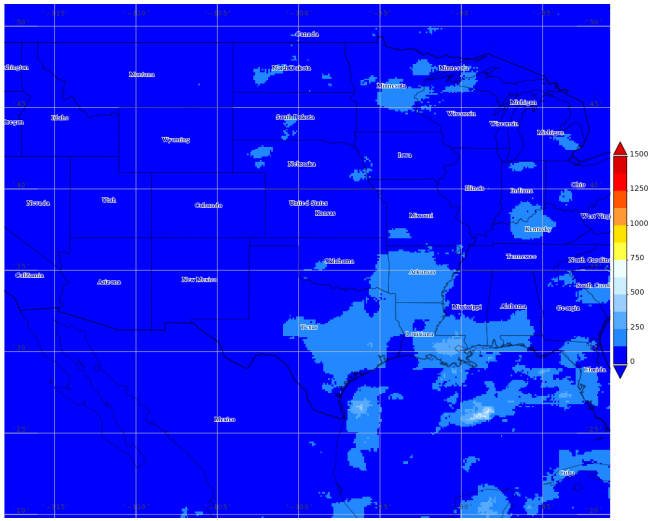
Image for the bottom part of the calendar



The rainfall accumulations for May, 2014, were quite different from May, 2015, as the southern Plains States suffered through the third year of a drought.

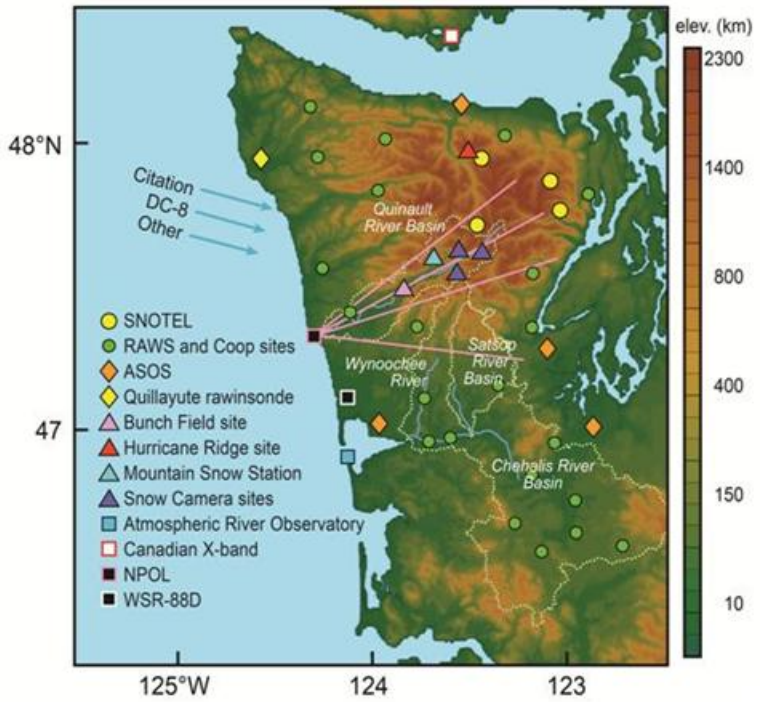
Comments:

- The thumbnail will be done in the same color table as the main, but the point is that there is very little precipitation in 2014. But, it's pretty boring, so maybe the satellite is a better graphic?

Next (final) Post-Launch NASA GPM GV Field Campaign
OLYMPEX: *Olympic Mountains Experiment in the Pacific NW*
Nov 2015 – Jan 2016

Science Goals:

- Physical Validation of GPM Precipitation Algorithms (rain and snow) for GMI and DPR
- Evaluation of GPM rainfall estimation uncertainty in context of precipitation mechanisms in midlatitude frontal systems and modification by terrain.
- Merger of numerical model and satellite observations to optimize precipitation estimation.
- Testing of hydrologic applications



Instrumentation:

- Surface: Special Rain gauge networks on Quinault and Chehalis, SNOTEL, Snow cameras, Disdrometers, hot plates, Pluvios……***NOAA?***
- Radars: WSR-88D, NPOL, D3R, EC X-band [Other requested radars: NSF DOW……]
- Aircraft: DC-8, ER-2 (ACE/RADEX), UND Citation; other potential aircraft (DOE G-1)

Status:

- Intensive planning, pre-IOP instrument deployments and testing are underway

GV: A Global Effort

CONUS/NOAA NMQ, **NASA VN** (Gauge/Radar)

EC Canada (Radars/Gauge)
(GCPEX;2012 CSPICE, 2013- **)**

U. Iowa/Flood Center
IFloodS; 2013

OLYMPEX; 2015

DOE ARM SGP
MC3E;2011

IPHEX; 2014

Melbourne FL
(Radar/Gauges)

Brazil
Operational /Research
Radars/Gauge networks
(CHUVA; 2010-14)

Argentina
Operational
Radars/Gauges

NASA WFF: Radar, disdrometers, gauges

Megha -Tropiques GV
(France: Radar, gauge, disdrometer)

EU, HSAF gauges, radars, disdrometers

Israel
Operational
Gauge/Radar
network

Finland: UH/FMI radars, gauges
(LPVEX 2010; Snow 2013- **)**

HyMEX (2012-)

Ethiopia
Blue Nile
Gauges

S. Korea (KMA)
Gauges, Radars

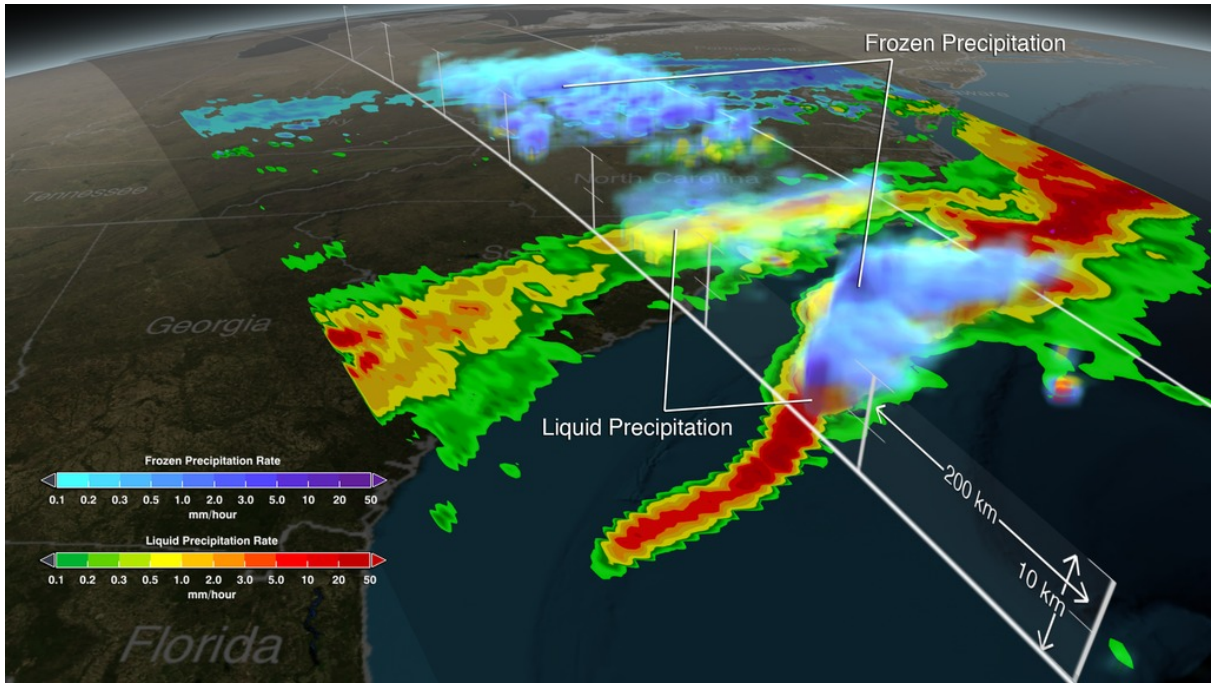
Japan (JAXA):
Radars, gauges,
disdrometers

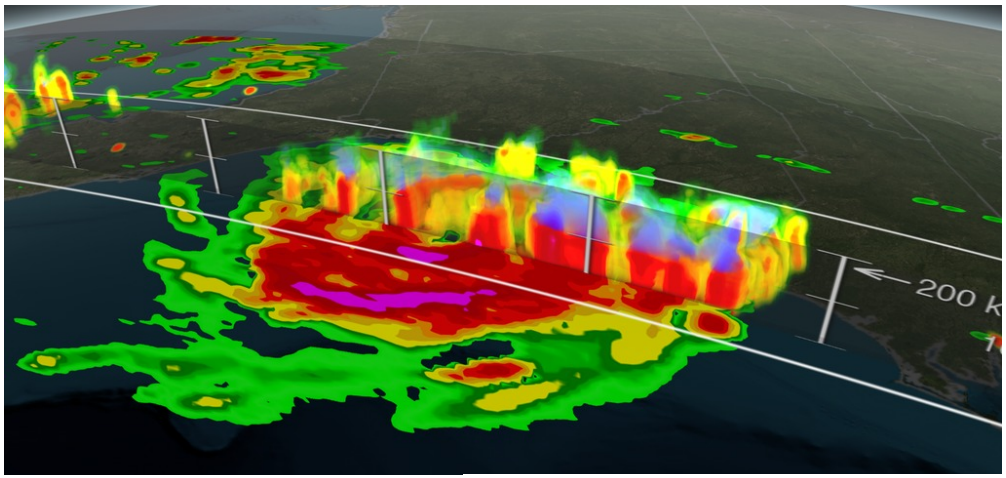
Kwajalein
Radar,
gauges,
disdrometers

Australia
Operational/Research
Radars/Gauges, Ship

GPM at 1 Year

The GPM Core Observatory lifted off at 3:37 a.m. JST on Feb. 28, 2014 from Tanegashima Space Flight Center, Japan





Top: Only 17 days after launch, GPM flew over its first snowstorm off the East Coast, demonstrating the capability to observe heavy rain, light rain and falling snow within the same storm and providing **new insight** into the precipitation melting layer

Left: Hurricane Arthur impacted the East Coast in early July, 2014. GPM observed Hurricane Arthur on July 3rd, providing a detailed 3-D picture of the storm as it was intensifying over the ocean.